SUMMARY REPORT

RESTORATION PLAN for the MOUNT HAGGIN, STUCKY RIDGE, and SMELTER HILL INJURED AREAS

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ACRONYMS

AERL ---------- ARCO Environmental Remediation, L.L.C.
ARWWS---------- Anaconda Regional Water, Waste and Soils
AUDB---------- Agency Upland Design Basis
BA ---------- Bare Areas
BMP---------- Best Management Practices
BRI ----------Bitterroot Restoration, Incorporated
CERCLA ----- Comprehensive Environmental Response, Compensation and Liability Act
COC ----------Contaminant of Concern
DG---------- Degraded Grassland Areas
DOI---------- United States Department of the Interior
EPA ----------United States Environmental Protection Agency
IG ---------- Impacted Grasslands
NA----------No Action
PTSG---------- Planting of Trees, Shrubs, and Grasses
RDP ----------Restoration Determination Plan
ROD---------- Record of Decision
SDG ---------- Steep Degraded Grassland Areas
SSR----------Steep Slope Reclamation Areas
UCFRB ---------- Upper Clark Fork River Basin
VI ----------Vegetation Improvement Treatment Areas
WV ---------- Well-vegetated

SMELTER HILL AREA UPLAND RESOURCES

Section 1: Introduction

Natural resource damages under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. § 9601 *et seq*., (CERCLA) are designed to compensate trustees[1] for injury[2] to natural resources[3] that are residual to CERCLA response actions.[4] In 1995 the State of Montana (State) issued a Restoration Determination Plan (RDP) as part of its natural resource damage assessment. Based on information then available about projected response actions to be undertaken, the RDP quantified the appropriate amount of natural resource damages to which the State was entitled in order to restore injured natural resources in the Upper Clark Fork River Basin (UCFRB). Among other resources, the RDP identified the costs to restore an area of uplands around the city of Anaconda (Smelter Hill Area Upland Resources or Uplands) (**Figure 1)**.

In September 1998, the Record of Decision (ROD) for the Anaconda Regional Water, Waste and Soils (ARWWS) was issued by the United States Environmental Protection Agency (EPA). The ROD included a general description of response actions to be undertaken in the Uplands. Based on the information contained in the ROD, in June of 1999, the State of Montana

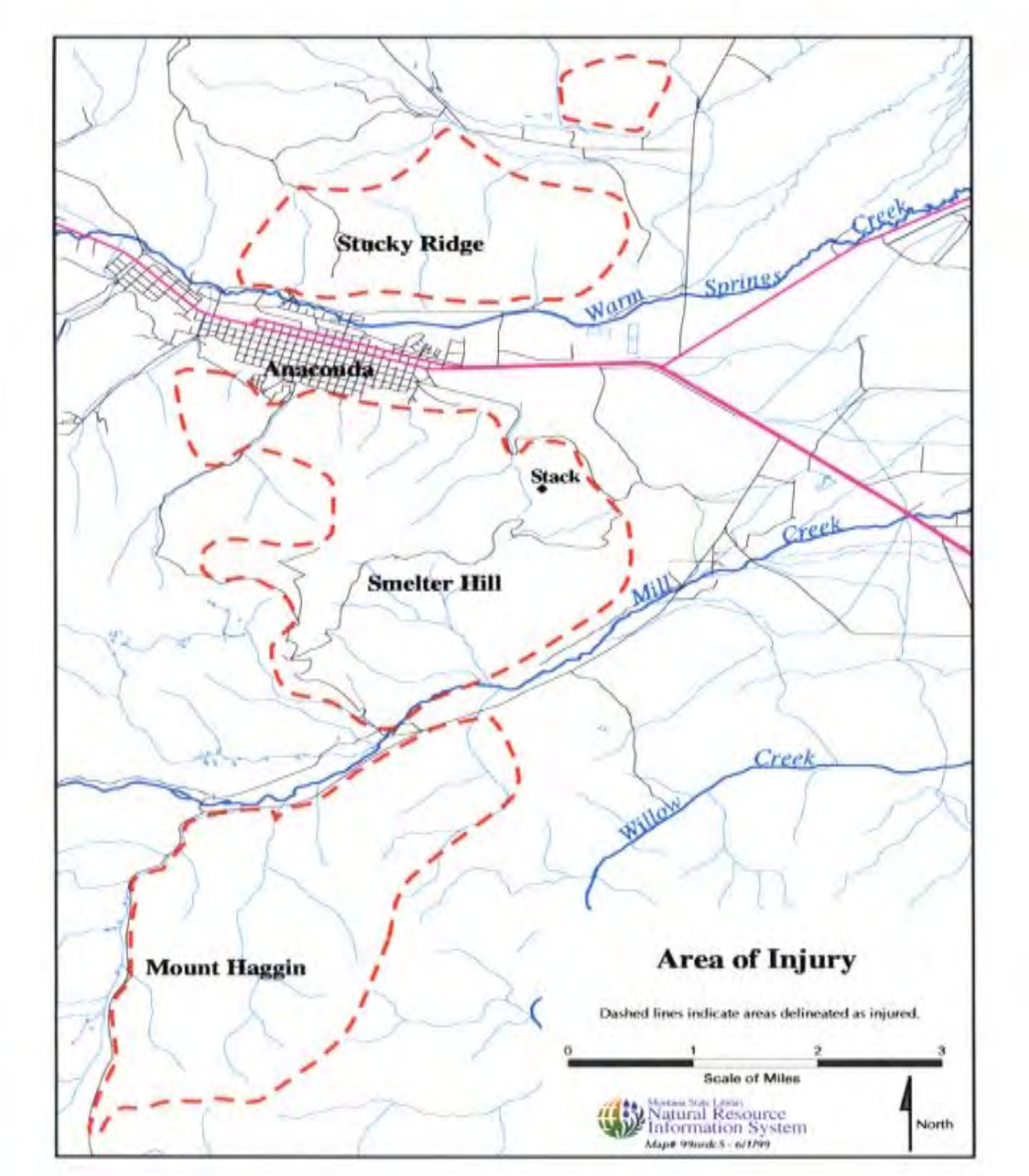
[1] The State of Montana is a trustee of natural resources within the state. CERCLA Section 107(f)(1), 42 U.S.C. § 9607(f)(1).

[2] As trustee, the State is entitled to "damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss resulting from" the release of a hazardous substance. CERCLA Section 107(a)(4)(C), 42 U.S.C. § 9607(a)(4)(C).

[3] "The term 'natural resources' means land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by" the State. CERCLA Section 101(16), 42 U.S.C. § 9601(16).

[4] "The terms 'respond' or 'response' means remove, removal, remedy, and remedial action." CERCLA Section 101(25), 42 U.S.C. § 9601(25).

FIGURE 1


Stucky Ridge
Warm Springs Creek
Anaconda
Stack
Smelter Hill
Mill Creek
Willow Creek
Mount Haggin
Area of Injury
Dashed lines indicate areas delineated as injured.
0 1 2 3
Scale of Miles
Natural Resource Information System
North

issued a *Revised Restoration Determination Plan, Smelter Hill Area Upland Resources* (1999 RDP). This document further revises the 1995 RDP with respect to restoration costs for the Uplands.

A second revision of the 1995 RDP is necessary and advisable because the State has recently received from ARCO additional information on proposed response actions in the Uplands in the form of draft remedial action work plans (Work Plans) showing polygon prescriptions for a remedial design.[5] These Work Plans more definitely set forth the expected nature and extent of EPA response actions than were set forth in the 1998 ROD. Based on information contained in these Work Plans, the State determined that the 1999 RDP did not accurately reflect the response actions to be undertaken by ARCO Environmental Remediation, L.L.C. (AERL) at the behest of the EPA nor the residual natural resource damages to which the State is entitled for restoration under CERCLA. Therefore, in this document, the State revises the 1999 RDP to reflect the most recent available information regarding response actions to be undertaken in the Uplands.[6]

As stated in the 1999 RDP, added certainty regarding response actions now enables the State to craft a restoration action that meshes with EPA's selected remedy. An integrated response/restoration action should maximize gains to the injured resources and result in a fairer and more accurate estimate of damages to which the State is entitled.

As in the 1995 and 1999 RDPs, this document characterizes the present condition of natural resources in the Uplands, describes EPA response actions, and arrays and examines

[5] Lists of references utilized in the preparation of this Revised Restoration Determination Plan are included in **Appendices A** and **B**.

[6] In this document, the State also attempts to address some of the comments on the 1999 RDP submitted by AERL and others.

alternatives for restoring the injured natural resources in the Uplands. The State selects an alternative using a list of factors devised by the United States Department of the Interior (DOI) and set forth in the natural resource damage assessment regulations. (43 C.F.R. Part 11.) The costs of the alternatives are itemized by their component parts. The alternative selected by the State in this document sets forth the amount of damages sought by the State in order to satisfy its claim for injury to the natural resources of the Uplands.

Procedures set forth in DOI's regulations were followed in the preparation of this revision of the RDP. These procedures provide that the public be given the opportunity to comment on the selection of alternatives for restoring injured resources. Accordingly, public comment will be accepted and responded to, and considered for this revised RDP.

1.1 Description of the Site and Injury[7]

The Uplands have been injured due to releases of hazardous substances from mineral processing activities. Enormous volumes of hazardous substances, including copper, arsenic, and cadmium were continually released into the air by these operations and subsequently deposited onto the land.

The primary source of hazardous substances to the Uplands was emissions from the Anaconda Smelter. Emissions from the Anaconda Smelter stack resulted in the deposition of hazardous substances across hundreds of square miles of surface soils surrounding and downwind of the stack. This resulted in injury to soils, vegetation, wildlife habitat, and wildlife.

The injury determination undertaken by the State for upland resources delineated those areas displaying gross (visible) injury attributable to the deposition of hazardous substances

[7] The information contained in this section is summarized from the State's 1995 *Terrestrial Resources Injury Assessment Report*.

released as smelter emissions and/or fugitive dust emissions. Grossly injured resource areas are defined as those areas which exhibit the following:

1) Complete or virtual elimination of major indigenous plant associations;

2) Little or no regeneration of major indigenous plant associations; and

3) Extensive topsoil exposure and erosion due to vegetation loss.

Upland areas which meet the grossly injured criteria extend across approximately 17.8 square miles (11,356 acres)[8] of land. The grossly injured area encompasses the eastern portion of Stucky Ridge and the hills on the north side of Lost Creek Road (2,408 acres), areas to the west and south of Smelter Hill (4,649 acres), and portions of the Mount Haggin Wildlife Management Area east of the Mill Creek Highway (4,299 acres). Elevations in the Injured Area range from 5,300 feet at the Stucky Ridge Injured Area to over 7,000 feet at the Mount Haggin Injured Area.

Soils in the Injured Area have elevated concentrations of hazardous substances including arsenic, cadmium, copper, lead, and zinc. Laboratory tests have confirmed that these soils are phytotoxic, which is consistent with visual observation of gross injury. Metal concentrations are highest in the upper two inches of soil. Elevated metal concentrations on the soil surface and upper soil layers prevent vegetation establishment, which explains the lack of natural recovery in the area. Absent human intervention, concentrations of hazardous substances in the soil will not be reduced sufficiently to allow for revegetation in a reasonable length of time.

In general, across the Injured Areas, there has been a shift in plant community types from coniferous forests and grassland to areas of sparse cover consisting of noxious weeds and some grasses or bare ground. In addition, stands of aspens are more prevalent than they would have

[8] This figure represents actual ground surface area. Measured in planimetric area, the Uplands is about 10,870 acres.

been had the area not been injured. Approximately one square mile of aspen is present on both the Smelter Hill and Mount Haggin Injured Areas.

Absent hazardous substances in the soil, the Injured Areas on Smelter Hill and Mount Haggin would have vegetative cover consisting of approximately 70% forest and 30% grassland, and the Injured Area on Stucky Ridge would have vegetative cover consisting of approximately 30% forest and 70% grassland. Of the total 11,356 acres that exhibit gross injury, 6,993 acres (62%) would have been primarily forestland and 4,373 acres (38%) would have been primarily grassland.

The elimination of upland vegetation communities in the grossly injured area has caused a severe disruption to the ecosystem. Most notable has been the drastic reduction in the quantity and quality of wildlife habitat.

1.2 Sources of Hazardous Substances

As noted above, the primary source of hazardous substances released to the Uplands was emissions from the Anaconda Smelter stack. Aerial deposition of these hazardous substances has resulted in widespread soil contamination. Mining and mineral-processing wastes disposed of in the Anaconda area are also sources of hazardous substances to the Uplands. Contaminated soils are, in turn, sources of on-going releases of hazardous substances through transport by the wind and redeposition onto the land surface and through surface runoff into water resources.

Section 2: CERCLA Response Actions and Residual Injury

2.1 CERCLA Response Actions

The State and its contractors have reviewed the ARWWS ROD, ARCO's draft remedial action Work Plans, and have participated in discussions with EPA and its contractors regarding this design. Although the exact details of the remedial actions to be undertaken in the Uplands remain to be determined, the Work Plans, with certain modifications anticipated by the State, set forth the remedial actions slated for the Uplands. In calculating the acreage to be addressed by response actions and in identifying specific actions, the State has relied on the determinations made in ARCO's Work Plans, as modified. While final work plans have not been adopted by EPA, ARCO's Work Plans, as modified, are the best information available to the State at this time. It is recognized that there may be changes in this anticipated design; however, such changes are not expected to be substantial.

ARCO's preliminary design packages and remedial action Work Plans are slated for reclamation on Stucky Ridge, Stucky Ridge North (a.k.a. Lost Creek), Smelter Hill, and Mount Haggin. Key components identified in the Agency Upland Design Basis (AUDB)[9] for successful reclamation include pH control, rootzone thickness, organic matter, vegetation selection, and other factors related to soil chemistry and application techniques.

The four basic revegetation remedies to be applied to the Injured Areas as proposed within the Work Plans are as follows.

[9] The AUDB, prepared by EPA's remedial contractor Montana State University-Reclamation Research Unit, defines restoration in a precise manner and recognizes the specific relationship between restoration, remedy, and the ROD.

1. **Well-vegetated**[10] **(WV) or No Action (NA) Areas** will receive no treatment other than weed control efforts as necessary.

2. **Steep Slope Reclamation Areas (SSR)** consist of slopes steeper than 3:1 and remedial actions will include planting of trees and shrubs and broadcast seeding (PTSG) as well as on-slope Best Management Practices (BMPs) such as brush boxes and dozer basins. Tree and shrub plantings will consist of 500 stems per acre including a 25% mortality factor. Four specific techniques have been identified:

    1) SSR-1 – hand broadcast seeding in conjunction with planting of trees and shrubs;

    2) SSR-2 – hand broadcast seeding in conjunction with planting of trees and shrubs and implementation of on-slope BMPs that do not require mechanized equipment;

    3) SSR-3 – hand broadcast seeding in conjunction with planting of trees and shrubs and implementation of on-slope BMPs requiring mechanized equipment; and

    4) SSR-4 – hand broadcast seeding in conjunction with planting of trees and shrubs and implementation of on-slope BMPs requiring mechanized equipment and slope regarding/recontouring.

3. **T6 and T12 Tillage Treatment Areas (Tillage)** in areas that are generally poorly vegetated, have low pH, elevated metal and/or arsenic levels, and slow rates of natural recovery. This technique will consist of tilling to the depth of 6 or 12 inches based upon soil pH and existing contaminant of concern (COC) concentrations. Amendments (liming application) will be applied and the area drill seeded. Areas of existing trees and acceptable vegetation will not be tilled. Also, crimped or mulched straw at a rate of one ton per acre will be applied to transition zones above SSR areas.

4. **Vegetation Improvement Treatment Areas (VI)** consist of areas containing some vegetation. A minimal level of treatment is proposed. Four specific techniques have been identified:

    1) VI-1 – weed spraying as necessary and light tilling (4 to 6 inches) with possible lime and/or fertilizer and drill seeding;

    2) VI-2 – weed spraying as necessary and surface scarification with possible amendments including lime and/or fertilizer application and drill seeding;

[10] The term "well-vegetated" is terminology utilized by AERL in the remedial action documents. The State does not agree that this term accurately describes, in a restoration sense, the parts of the Injured Area to which it refers.

3) VI-3 – weed spraying as necessary and surface scarification with broadcast seeding and fertilization; and

4) VI-4 – weed spraying as necessary with broadcast seeding and/or broadcast fertilization.

The principal objective of these efforts will be to stabilize contaminated and eroding soils through the establishment of metal tolerant vegetation with minimal diversity. Plant species established will be predominantly trees, early and mid-successional shrubs, drought and metal tolerant grasses, and early successional forbs. Vegetation will harvest infiltrating precipitation, reduce wind and water erosion, reduce COC exposure to wildlife, and provide consistency with anticipated future land uses.

2.2 Residual Injury

Residual injury is the injury to natural resources that remains substantially unaddressed following implementation of the remedy. This concept is predicated on the fact that response actions can improve the condition of injured natural resources and thereby lessen natural resource injury. The AUDB recognizes, however, that "remedy . . . will only meet the Remedial Action Goals and Objectives as stated in the ROD, thereby falling short of a restored condition." The State recognizes that the remedy effort will provide site stability, reduced exposure of wildlife to COC and sustainable vegetative cover in a number of areas, but also believes that a baseline condition[11] will not be achieved.

After implementation of the remedy, and in the absence of further restoration measures, natural resources in the Uplands will exhibit the following characteristics of residual injury:

1) Soils will be stabilized with reduced erosion in some areas, but some areas remain highly mineralized and low in fertility;

[11] DOI regulations define the term "baseline," as the condition of the resource had the release of hazardous substances not occurred. (43 C.F.R. §11.14(e).)

2) Plant species richness in some areas will consist of native and non-native reclamation plant species but will lack species richness characteristic of baseline conditions, especially for trees and shrubs.

3) Plant establishment, especially in Mount Haggin, will be limited to areas located adjacent to existing stands of native vegetation;

4) Metal tolerant species, especially the forb component, rather than species characteristic of baseline conditions, will be the dominant component of the plant community; and

5) Vegetation patterns or structure (i.e. the proportion of forest to grassland) will not replicate the natural distribution of native vegetation.

Reclaimed areas will lack the structural and compositional features of the baseline fescue grassland communities. Based upon the Remedial Action Work Plan for Lost Creek (AERL 2001), grass plantings will include drought tolerant, rhizomotous species with a minor component of forbs adapted to disturbance conditions. Minimal insect pollinated species will be reintroduced.

Reclaimed steep slope areas will also lack the structural and composition features of the baseline plant communities. Based upon the Work Plan, a variety of native woody species will be planted on steep slopes identified as SSR-1. The Work Plan does not propose to restore baseline conditions, however. The contaminated soils between the planted woody species will not be limed and will remain phytotoxic. These areas will be dominated by metal tolerant grasses and weed species indefinitely, and species typical of baseline conditions will not recover naturally on these areas.

Functionally, plant cover resulting from remedy efforts will result in some erosion control and provide limited forage for wildlife. Forage will be limited to grass species within grassland remedy areas and woody browse on steep slopes and those areas of existing vegetation. The ability of this regime to provide for adequate retention and cycling of nutrients is limited.

Remedy will provide compost application to limited areas that will serve to increase the retentive qualities of the soil and fertilization will occur with standard conventional fertilizer to increase soil fertility. Given the characteristic of high solubility of conventional fertilizers, this fertility may be quickly lost unless compost or vegetation can retain or incorporate nutrients into less soluble forms.

Durability of the remedy will be limited based upon the ability of cover and complexity of vegetation to prevent weed invasion and a potentially limited nutrient pool. SSR areas will remain highly susceptible to weed invasion due to areas of bare ground and residual contamination. Inadequate plant coverage may result in further erosion on SSR areas and expansion of noxious weed infestations. A limiting factor in recovery to baseline will be the residual damage on SSR areas, soil development factors, and individual species' ability to migrate and invade successfully. Extended time to recovery may result in wind and water erosion on SSR areas where residual contamination exists, causing further exposure to surface water, wildlife and humans to elevated levels of COCs.

In summary, plant species richness, abundance and structure resulting from remedy will be substantially lower than a baseline ecosystem. Plant and grass species abundance under the remedy will suffer compared to baseline. For example, a planting density of 500 plants per acre will not result in the abundance of wildlife forage or cover found under baseline conditions. Plant species structure (i.e. the proportion of forest to grassland) will not replicate the structure present under baseline conditions.

In addition, restoration efforts could be initiated that would significantly reduce the time for injured resources to recover to baseline. Soil structure could be modified to create conditions that would support a greater variety of plant species and reduce the time required for plant

succession. Amendments such as lime could be applied to steep slope treatment areas which would further reduce the influence of COCs on plant community development, and proposed fertilization practices could be modified in order to more effectively build nutrient resources within the soil and to favor native perennial species.

Section 3: Restoration

3.1 Introduction

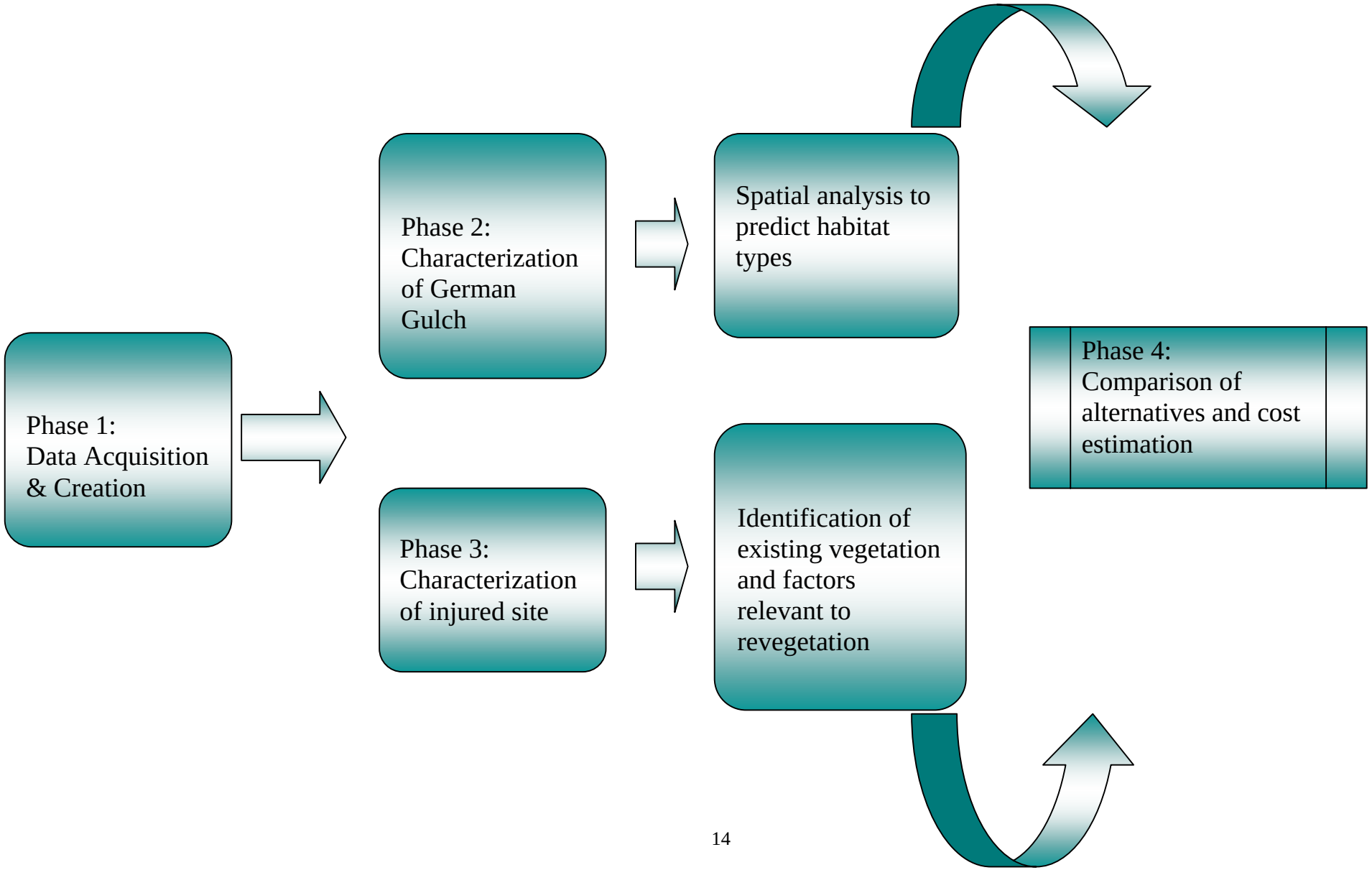
In 1999, the State employed Bitterroot Restoration, Inc. (BRI) to conduct field investigations and develop a revised restoration plan for the Upland Injured Areas. Since 1986, BRI has provided restoration services throughout the United States for private, commercial and governmental entities. In 2000 and 2001, BRI conducted numerous field investigations throughout the injured and reference areas and generated two reports, attached as appendices to this plan. These reports are the *Ecological Restoration Plan for the Stucky Ridge and Smelter Hill Injured Areas* (**Appendix A**) and *Ecological Restoration Plan for the Mount Haggin Injured Area* (**Appendix B**). These reports contain characterizations of the injured and reference areas and comparisons of restoration alternatives including specifications of restoration treatments, descriptions of restoration species, detailed restoration prescriptions, and cost sheets for the various restoration prescriptions.

BRI developed the restoration alternatives set forth in this report through integration of in-field characterizations of site conditions with computer-based planning tools. BRI designed the restoration planning process to predict species and species distribution, take into account response actions, and identify methodologies and techniques for implementation of effective restoration of the injured natural resources of the Uplands.

As depicted in **Figure 2**, restoration planning proceeded in four phases. During Phase 1, field investigators generated and acquired data to support subsequent phases.

In Phase 2, the German Gulch Reference Area was surveyed to determine the diversity of vegetation habitat types and the distribution of specific plant species that would have been

Figure 2


Phase 1:
Data Acquisition
& Creation
Phase 2:
Characterization
of German
Gulch
Phase 3:
Characterization
of injured site
Spatial analysis to
predict habitat
types
Identification of
existing vegetation
and factors
relevant to
revegetation
Phase 4:
Comparison of
alternatives and cost
estimation

present in the Injured Areas in the absence of injury caused by emissions from Anaconda area smelting operations. The survey was conducted using a reconnaissance method known as "habitat typing." The purpose of habitat typing at German Gulch was to observe habitat types on specific landscape positions in order to create a habitat suitability model, or template, for development of restoration prescriptions in the Injured Areas. The following procedures were utilized to develop this habitat suitability model:

- The diversity and distribution of habitat types were observed through a field investigation of the German Gulch Reference Area during the springs of 2000 and 2001;
- Existing habitat types were described based upon field observations and published reference material; and
- A habitat suitability model was developed that describes both the distribution of existing habitat types at German Gulch and predicted (restored) vegetation at the Injured Areas.

Specific details of these procedures are outlined in Section 3 of **Appendices A** and **B**. The habitat suitability model indicates that approximately 25 percent of the Mount Haggin Injured Area would have supported intermountain grassland and shrub communities with the remaining 75 percent of the site supporting forest stands primarily composed of Douglas fir habitat types. Approximately 35 percent of the Smelter Hill Injured Area would have supported intermountain grassland and shrub communities and 65 percent would have supported forest stands composed primarily of Douglas fir habitat types. At Stucky Ridge, approximately 65 percent of the Injured Area would have supported intermountain grassland and shrub communities with the remaining 35 percent of the site supporting forest stands composed of Douglas fir habitat types. These findings are very similar to conclusions drawn from the State's 1995 *Terrestrial Injury Report*.

In Phase 3 of restoration planning, the Injured Areas were investigated in order to verify the extent and character of injury in these areas. *See* Section 4 of **Appendices A** and **B**. The

purpose of these investigations was to identify and provide supportive evidence for the use of specified site restoration techniques. The Mount Haggin Injured Area was investigated in the summer of 2000 and the Smelter Hill and Stucky Ridge Injured Areas were investigated in the summer of 2001. The findings from these investigations and restoration strategies for the areas are summarized in the next two subsections.

3.2 Mount Haggin Field Results

BRI sampled a total of 40 sites (10 barren and 30 grass sites) in the summer of 2000. A map developed in 1994 by AERL's consultant Warren Keammerer was the main source used to identify these sample sites. During sampling, BRI scientists recorded site attributes including: bare ground; low quality grass cover; high quality grass cover; woody plant cover; type of erosion observed; litter and woody debris presence; seedbed surface; and areas of exposed rock. The field investigators also recorded a general description of the site with comments about the site conditions and challenges to and opportunities for restoration. The end point of these efforts was an estimate of acreage requiring restoration at the injured site. The main areas identified which require specific restoration treatments are 267 acres of bare areas (BA), 246 acres of steep degraded grassland areas (SDG), 344 acres of degraded grassland areas (DG) and 1713 acres of impacted grassland (IG).

3.3 Restoration Strategies for Mount Haggin

Based on these field observations, BRI developed strategies to restore the Injured Area which would be used to develope restoration alternatives. All areas will be treated by aerial or hand manual efforts. No roads are proposed to be constructed in the IA. To restore BA lacking

vegetation, soil organic matter that provides nutrients and moisture retention, and soil organisms, BRI proposed to address the following objectives:

- Shorten effective slope lengths by use of fabric (coir wattle) logs to control erosion;
- Reduce the availability of metals;
- Increase soil fertility and organic matter to support a more vigorous vegetation;
- Add an erosion-resistant wood fiber mulch layer to the surface to allow grass to become established on currently unstable soil surfaces;
- Establish grass and forbs on the soil surface;
- Provide favorable microsites for plant growth;
- Establish a more diverse and greater density of native plant cover through active planting efforts; and
- Eliminate and control existing noxious weed species.

The proposed restoration strategy for SDG and DG, which lack vegetation, soil organic matter that provides nutrients and moisture retention, and soil organisms, is to address the following objectives:

- Shorten effective slope lengths where slopes are greater than 35%;
- Reduce the availability of metals;
- Increase soil fertility and organic matter to support a more vigorous vegetation;
- Provide favorable microsites for plant establishment;
- Establish a greater diversity and density of native plant cover through active planting efforts; and
- Eliminate and control noxious weed species.

The proposed restoration strategy for IG which lack species diversity compared to baseline is to establish native shrubs and trees according to site potential as predicted by

elevation and aspect. Detailed restoration components are given by specific restoration alternatives in Section 6 of **Appendix A**.

3.4 Smelter Hill and Stucky Ridge Field Results

BRI sampled a total of 86 sites in the Smelter Hill and Stucky Ridge Injured Areas in the summer of 2001. AERL maps generated during the CERCLA RI/FS process were the main source used to identify these sampling sites. During sampling, BRI scientists, as in the Mount Haggin Injured Area, recorded the field attributes of the site. The field investigators also recorded a general description of the site with comments about the site conditions and challenges to and opportunities for restoration. Unlike the Mount Haggin Injured Area which has almost no remedial prescriptions,[12] areas designated by the State for restoration on the Smelter Hill and Stucky Ridge Injured Areas were identified based primarily on the remedial prescriptions already selected for the area in the ARWWS OU ROD. The main areas which require restoration treatments above treatments proposed by remedy are described using terminology from the ARWWS OU ROD and Work Plans, and quantified as follows:

- Tillage areas.....1768 acres;
- Steep slope reclamation (SSR).....1580 acres;
- Well Vegetated (WV) .....1106 acres; and
- Vegetation Improvements (VI)..... 246 acres.

[12] Remedial prescriptions for the 4,091 acre Mount Haggin Injured Area cover only 54 acres, on which SSR is planned.

3.5 Restoration Strategies for Smelter Hill and Stucky Ridge

As with the Mount Haggin Injured Area, based on the field observations at the Smelter Hill and Stucky Ridge Injured Areas, BRI developed strategies to restore the Injured Areas that would be used to develop restoration alternatives. The expected remedy for Tillage areas is tilling to a 6- or 12-inch depth, applying lime and inorganic fertilizer and drill seeding with an upland herbaceous species mix. Although soil disturbance, seeding and liming will enhance productivity at the site, few of the dominant species characteristic of baseline conditions on these areas will actually be planted on the Injured Area during implementation of the remedy. As a result, future conditions under the proposed remediation scenario will reflect an inadequate species composition and cover for most of the dominant plant species characteristic of baseline.

The proposed restoration strategy for the Tillage areas is to return a significant proportion of dominant and sub-dominant species characteristic of baseline conditions through enhancement planting and seeding of native species to these areas. In addition, organic matter will be added to significantly improve soil conditions for plants and planting. Little addition of organic matter is proposed under the present Work Plans and should more organic matter be used during remedial efforts than is presently proposed, less will be needed for restoration. Multiple applications of slow-release organic fertilizer would also improve site conditions for growth and survival. Finally, biological weed control and management will be an aspect of restoration efforts.

The expected remedy for SSR areas calls for planting of 500 trees/shrubs per acre, broadcast seeding, soil stabilization measures such as dozer basins, dams, silt fences, grading, and sediment barriers such as straw bales and wattles. Assuming the erosion control measures proposed in the remedial prescriptions for the SSR areas are successful, such measures may have similar benefits as the coir wattle logs proposed for restoration of the Mount Haggin Injured

Area steep slopes. Success of the tree planting efforts would be enhanced with the utilization of tree protectors, currently not prescribed under the remedy. Also, treatment of metals contaminated low pH soils, not currently prescribed under the remedy, would enhance the success of broadcast seeding. Although seeded dozer basin areas should result in grass establishment locally in the disturbed areas, grass may not become established in much of the undisturbed area under the present remedial prescriptions. As a result, future conditions under the proposed remediation scenario will reflect an inadequate species composition and cover for several of the dominant species characteristic of baseline on SSR areas.

The proposed restoration strategy for the SSR areas is to return a significant proportion of expected dominant and sub-dominant species by augmenting remedial plantings to expand species diversity and provide a greater density of cover. Tree protectors should be used during planting of trees and shrubs to enhance growth and survival of plants. Prior to planting, soil will require lime amendment to help neutralize acidity and reduce trace element availability, both of which would significantly improve soil conditions for plant growth and survival. Further, the high composition of gravel and rock will present challenges to restoration. The addition of aerial applications of compost and fertilizer would also improve soil conditions for plants.

The expected remedial prescription for VI areas calls for a minimal level of treatment depending on the amount of existing vegetation. These treatments entail weed spraying, light tilling, possible lime amendments, drill or broadcast seeding, and inorganic fertilization. Few of the dominant species characteristic of baseline conditions on these areas will actually be planted during implementation of the remedial prescription. As a result, future conditions under the proposed remediation scenario will reflect an inadequate species composition and cover for most of the dominant species characteristic of baseline at the areas.

The proposed restoration strategy for the VI areas is to return a significant proportion of dominant and sub-dominant species characteristic of baseline conditions by planting of native species. Also proposed is mechanical compost application and organic fertilizers.

The expected remedy for the WV areas calls for no treatment other than inorganic weed control efforts if necessary. Tree and/or shrub plantings are proposed under restoration to bring these areas closer to baseline. Detailed restoration components are set forth in the specific restoration alternatives listed in Section 6 of **Appendix B**.

Section 4: Evaluation of Alternatives

4.1 Mount Haggin Injured Area

For the Mount Haggin Injured Area, the State evaluated three restoration alternatives that vary in intensity (*see* **Table 1 and Table 2**), length of time for recovery to baseline conditions, risk of continued site degradation, and cost. The alternatives considered by the State are:

- No Action Alternative;
- Site Stabilization Restoration Alternative; and
- Active Restoration Alternative.

The goal of the *No Action Alternative* is to allow areas treated by remedial action prescriptions, to follow a recovery trajectory dictated by site conditions. This alternative will rely entirely upon natural recovery and could result in a time for recovery to baseline conditions of about 500 years, a steady state consisting of only those plant species utilized in the few areas on which remedial prescriptions will be implemented, or a trajectory of site degradation with no or minimal restoration of natural resources. This alternative will not actively pursue restoration and will not result in ecosystem health, richness of plant species, or diversity of structure characteristic of baseline conditions.

The goal of the *Site Stabilization Restoration Alternative* is to restore functional erosion control and conditions that will initiate a recovery trajectory that allows the natural resources to move toward baseline conditions. Components of this alternative include installation of physical erosion control measures, seeding, fertilizer application, lime application, and maintenance as necessary. Implementation of this alternative will result in noticeable recovery of natural resources toward baseline conditions in a relatively short period of time, i.e., a number of

TABLE 1

	Bare Areas		**Steep, Degraded Grasslands**		**Degraded Grasslands**		**Steep Slope Reclamation (SSR)**		**Impacted Grasslands**[13]	
	site stabilization	**active restoration**	**site stabilization**	**active restoration**	**site stabilization**	**active restoration**	**site stabilization**	**active restoration**	**site stabilization**	**active restoration**
Site Prep./ Amelioration Treatments										
Erosion Control and Sediment Retention Wattle (ESW) Installation (Specification 6.1)	X	X	X	X						
Aerial Application of Agricultural Lime (Specification 6.2)	X	X	X	X	X	X	X	X		
Aerial Application of Fertilizers- Initial Rate (Specification 6.5)	X	X	X	X	X	X		X		
Aerial Application of Compost (Specification 6.6)		X		X		X				
Seeding/ Planting Treatments										
Aerial Seeding (Specification 6.3)	X	X	X	X	X	X				
Aerial Application of Hydromulch (Specification 6.4)	X	X								
Restoration Enhancement Planting (Specification 6.7)		X		X		X		X		X
Install Plant Protectors (Specification 6.8)		X		X		X		X		X
Maintenance										
Aerial Application of Fertilizers- Maintenance Rate- Year 4 (Specification 6.9)	X	X	X	X	X	X				
Maintenance of Erosion Control and Sediment Retention Wattles (Specification 6.10)	X	X	X	X						
Maintenance of Plant Protectors (Specification 6.11)		X		X		X		X		X
Replacement Plant Installation (Specification 6.12)		X		X		X		X		X
Noxious Weed Control (Specification 6.13)	X	X	X	X	X	X	X	X	X	X
Restoration Monitoring (Specification 6.14)	X	X	X	X	X	X	X	X	X	X

[13] Includes monitoring-well vegetated sites as proposed by ARCO.

TABLE 2 Summary of Alternatives for Mount Haggin

	No Action	**Stabilization Restoration**	**Active Restoration**
Primary Strategy	Natural recovery	Active erosion control for surface soil stabilization	Active planting efforts with surface soil treatments
Techniques	Remedial action treatments (some areas)	Remedial Action Treatments (some areas) Erosion Control Wattle Installation Fertilizer Application Lime and Seed Application Maintenance Fertilization Noxious Weed Control	Remedial Action Treatments (some areas) Restoration Enhancement Plantings Fertilizer Application Lime and Seed Application on "SSR" Surface Compost Application Noxious Weed Control
Technical Feasibility	Actions are technically feasible	Actions are technically feasible and typical of forestry, mineland reclamation, & contaminated site cleanup/products commercially available	Actions are technically feasible and typical of forestry, mineland reclamation, & contaminated site cleanup/products commercially available
Coordination with Remedy	No coordination required	Possible to coordinate several functions in limited remedy area and reduce costs	Possible to coordinate several functions in limited remedy area and reduce costs
Anticipated Ecological Response	Functional replication	Functional erosion control with minimal compositional /structural replication	Functional and partial compositional/structural replication
Effectiveness & Risks of Strategy	High risk—resulting restoration may not recover to baseline and may further degrade	Moderate risk—erosion control species will establish, but soil factors may inhibit further succession and extend recovery	Moderate risk—mid-successional species will establish, but soil factors may inhibit further succession and extend recovery
Potential of Additional Injury	Potential erosion and noxious weed invasion on slopes	Soil disturbance will possibly result in noxious weed establishment	Soil disturbance will possibly result in noxious weed establishment
Potential Effects on Human Health and Safety	Extended exposure to COCs from eroding slopes	Short-term exposure to implementation crews to COCs.	Short-term exposure to implementation crews to COCs
Appropriate Application Area	"M WV" adjacent to native stands	Highly eroding sites with limited species diversity and soils with chemical and physical deficiencies	Sites with limited species diversity and soils with chemical and physical deficiencies
Time for Recovery to Baseline	>500 years	>250 years	<100 years
Anticipated Costs	$ 0.00	$ 13,479,605	$ 28,139,569

decades. Climax species composition and structural diversity are not of concern for this alternative which would rely on natural recovery to some degree, and result in a time period for recovery to baseline conditions of around 250 years, excepting soil development which may take substantially longer to reach baseline.

The goal of the *Active Restoration Alternative* is to restore mid-successional plant communities and initiate a trajectory of recovery toward baseline conditions. Components of this alternative include enhancement plantings that provide five additional species to site richness, application of amendments to plantings, initial fertilizer application, lime treatments, and maintenance as necessary. The focus of this alternative is to increase species richness on areas. Noticeable recovery of natural resources toward baseline will occur in a shorter period of time than under the other alternatives, and complete recovery of natural resources to baseline, excepting soils, will occur in a shorter time period than under the *Site Stabilization Restoration Alternative* due to extensive plantings across much of the Injured Area and the appropriate distribution of grassland and woody species prescribed in this alternative. As with the other alternatives considered by the State, this alternative would rely upon natural recovery to some degree, and should result in site stability, sustained use by a variety of wildlife species and recovery to baseline conditions, excepting soil development, within less than 100 years.

4.1.1 Technical Feasibility

Based on the restoration goals for each of the injured areas, BRI developed restoration treatments for these areas which are set forth in Section 6 of **Appendix A**. The treatments slated for both the *Site Stabilization* and *Active Restoration Alternative*s are technically feasible and are typical of forestry and mine land reclamation.

4.1.2 Cost-Effectiveness

The restoration benefits to natural resources of the Mount Haggin Injured Area vary greatly between the three alternatives. None of the alternatives considered by the State would result in immediate restoration to baseline conditions. Cost-effectiveness of the alternatives was evaluated on how well implementation of each alternative would result in site conditions that will optimize the chances for natural recovery to eventually result in baseline conditions.

The *No Action Alternative* produces no restoration benefits beyond those that may result from natural recovery. The *Site Stabilization Restoration Alternative* proposes restoration actions on 911 acres, or 22% of the Mount Haggin Injured Area. Although this alternative does not include measures designed to optimize restoration of climax species composition and structural diversity, the measures proposed under this alternative will accomplish the stated purpose of erosion control enhancement and establishment of vegetation on areas of particular need within the Injured Area. And, although this alternative may not result in restoring baseline conditions to all of the Injured Area, the alternative will create conditions designed to promote recovery to baseline conditions and, compared to the *No Action Alternative*, significantly reduces

the time of recovery to baseline conditions for the natural resources of the Mount Haggin Injured Area.

The *Active Restoration Alternative* proposes restoration activities on 2,625 acres, or 64%, of the Injured Area. In addition to the stabilization measures proposed under the *Site Stabilization Restoration Alternative*, the *Active Restoration Alternative* will create conditions necessary for the restoration of climax species composition and structural diversity similar to baseline conditions. The restoration benefits of this alternative will be substantial and the time of recovery to baseline conditions will be reduced significantly over the *Site Stabilization Alternative*.

4.1.3 Results of Response Actions

Of the 4,091 acres in the Mount Haggin Injured Area, only 54 acres are to be addressed by the remedial action. These areas are slated for Steep Slope Reclamation (SSR), which entails erosion control measures, broadcast seeding, and planting of 500 trees/shrubs per acres. Restoration actions under either of the State's restoration alternatives can be fully coordinated with remedy. Restoration treatments under the *Site Stabililization Restoration Alternative* for the SSR areas are aerial application of fertilizer and lime, and biological weed control. In the *Active Restoration Alternative*, enhanced plantings, aerial application of lime and fertilizer, and biological weed control is proposed.

4.1.4 Potential for Additional Injury

Environmental impacts resulting from either restoration alternative will be short-term and insignificant. Such impacts may include dust disturbance during organic matter and fertilizer

placement. Measures designed to mitigate any adverse impacts will be taken. Selection of the *No Action Alternative,* however, will result in continued significant adverse impacts to natural resources in the Mount Haggin Injured Area such as further erosion, noxious weed invasion, an extensive amount of time for recovery of natural resources to baseline conditions, a steady state consisting of only those vegetation species utilized in remedial prescriptions, or a trajectory of site degradation with no or minimal restoration of natural resources.

4.1.5 Natural Recovery and the Ability of the Resource to Recover

Due to the severe injuries in the Mount Haggin Injured Area, estimating time of recovery to baseline is a difficult task. Restoration actions, however, will enhance the ability of the resource to recover by creating site-specific conditions favorable to, in the long term, restoration of baseline conditions. As stated in the previous section, a failure to implement restoration actions could result in further erosion, noxious weed invasion, an extensive amount of time for recovery of natural resources to baseline conditions, a steady state consisting of only those vegetation species utilized in remedial prescriptions, or a trajectory of site degradation with no or minimal restoration of natural resources. Without implementation of restoration actions, it would likely be many centuries before baseline conditions return to the Mount Haggin Injured Area. Implementation of restoration actions, however, will result in substantial recovery of natural resources toward baseline conditions within a few decades and will produce noticeable improvements in aesthetics and wildlife habitat within the short-term. The timeline for complete recovery of natural resources to baseline conditions under the *Site Stabilization Restoration Alternative*, with the exception of soil development, should be significantly shortened to a time period of around 250 years, occurring first in the areas where restoration actually occurs (22% of

the Injured Area). Time for recovery to baseline conditions, with the exception of soils, under the *Active Restoration Alternative* may be further shortened to between 50 and 100 years.

4.1.6 Human Health and Safety

There are no significant human health and safety issues associated with these alternatives. Alternatives would be designed and implemented to ensure both workplace safety and public health.

4.1.7 Federal, State, and Tribal Laws

The alternatives are consistent with applicable law. Before taking any action the State would obtain all necessary permits and authorizations.

4.1.8 Cost-Benefit/Decision Making Analysis

The costs of the alternatives, which are displayed on the attached cost sheets (**Table 3)**, are $0 for the *No Action Alternative*, $13.5 million for the *Site Stabilization Restoration Alternative* and $28.1 million for the *Active Restoration Alternative.* The State selects the *Site Stabilization Restoration Alternative* with the additional component, from the *Active Restoration Alternative*, of the prescribed tree and shrub plantings on all the treatment areas except the "impacted vegetation" category that will receive the prescribed tree/shrub plantings on half the areas within this category. The total area of Mount Haggin that will receive restoration actions will be 1768 acres, or 43% of the IA. This added component of tree/shrub plantings will increase the cost of the selected alternative by $6.3 million for a total restoration cost of $19.8 million for the Mount Haggin IA.

This alternative does not achieve all of the restoration goals of the *Active Restoration Alternative* such as restoration of climax species composition and structural diversity similar to baseline conditions on 64% of the site. The selected alternative, however, addresses the most severely impacted areas (43%) of the Mount Haggin Injured Area, allows enhancement planting

TABLE 3

MOUNT HAGGIN COSTS

Treatment	Acres	SSA[1] cost/acre	ARA[2] cost/acre	Total to Implement SSA	Total to Implement ARA
Bare Areas	267	$23,690[3]	$33,542	$6,325,413	$8,955,791
Steep, Degraded Grasslands	246	$14,533	$24,385	$3,581,127	$6,008,563
Degraded Grasslands	344	$9,112	$18,963	$3,138,288	$6,531,180
Steep Slope Reclamation (SSR)	54	$5,434	$8,969	$293,472	$484,363
Impacted Vegetation	1,713	$82.49	$3,595	$141,301	$6,159,670
TOTALS	**$2,625**			**$13,479,605**	**$28,139,569**

[1] SSA – Site Stabilization Alternative
[2] ARA – Active Restoration Alternative
[3] All costs listed in the above Table are adjusted for Net Present Value

of trees and shrubs on 1,768 acres, and relies on natural recovery for the majority of the Injured Area.

The State does not select the *No Action Alternative* because of the significant risk of further erosion, noxious weed invasion, an extensive amount of time for recovery of natural resources to baseline conditions, a steady state consisting of only those vegetation species utilized in remedial prescriptions, or a trajectory of site degradation with no or minimal restoration of natural resources inherent in this course of action. Although complete restoration of baseline conditions under the selected alternative may take around 250 years, this alternative proposes reasonable measures designed to optimize site-specific conditions favorable to restoration of baseline conditions at approximately one-half the cost of the *Active Restoration Alternative*. Additionally, within a few decades, this alternative will move resources toward baseline conditions producing substantial aesthetic and wildlife habitat benefits.

4.2 Smelter Hill and Stucky Ridge Injured Areas

For the Smelter Hill and Stucky Ridge Injured Areas, the State evaluated three restoration alternatives which vary in intensity (*see* **Table 4 and Table 5**), length of time for recovery to baseline conditions, risk of continued site degradation, and cost. The alternatives considered by the State are:

- No Action Alternative;
- Active Restoration Alternative; and
- Intensive Restoration Alternative.

TABLE 4

	Tillage (T6 & T12)		Vegetation Improvement (VI)		Steep Slope Reclamation (SSR)		Well Vegetated (WV)	
	Active Restoration	**Intensive Restoration**	**Active Restoration**	**Intensive Restoration**	**Active Restoration**	**Intensive Restoration**	**Active Restoration**	**Intensive Restoration**
Site Preparation/ Amelioration Treatments								
Aerial Application of Agricultural Lime (Specification 6.1)					X	X		
Aerial Application of Fertilizers- Initial Rate (Specification 6.4)					X	X		
Aerial Application of Compost (Specification 6.5)						X		
Mechanical Compost Application/ Incorporation (Specification 6.6)		X						
Mechanical Fertilizer Application- Initial Rate (Specification 6.8)	X	X						
Mechanical Compost Application- Surface (Specification 6.9)	X		X	X				
Seeding/ Planting Treatments								
Aerial Seeding (Specification 6.2)						X		
Aerial Application of Hydromulch (Specification 6.3)						X		
Broadcast Seeding- Enhanced Mix (Specification 6.7)		X		X				
Restoration Enhancement Planting- 500 plants/acre (Specification 6.10)	X		X		X		X	
Restoration Enhancement Planting- 1,000 plants/acre (Specification 6.10)		X		X		X		X
Install Plant Protectors (Specification 6.11)	X	X	X	X	X	X	X	X
Maintenance								
Aerial Application of Fertilizers-Maintenance Rate (Specification 6.12)		X		X		X		
Maintenance of Plant Protectors (Specification 6.13)	X	X	X	X	X	X	X	X
Replacement Plant Installation (Specification 6.14)	X	X	X	X	X	X	X	X
Noxious Weed Control (Specification 6.15)	X	X	X	X	X	X	X	X
Restoration Monitoring (Specification 6.16)	X	X	X	X	X	X	X	X

Table 5 Summary of alternatives for Smelter Hill and Stucky Ridge

	No Action—Natural Recovery	**Active Restoration**	**Intensive Restoration**
Primary Strategy	Natural recovery	Active planting efforts with surface soil treatments.	Active planting efforts with surface and sub-surface soil treatments
Techniques	Remedial action treatments	Remedial Action Treatments Restoration enhancement plantings (500 stems/acre) Organic Fertilizer application Aerial Lime application on SSR Surface compost application (34 cy/ac) Biological Noxious weed control	Remedial Action Treatments Sub-surface compost application (200+ cy/ac) Restoration enhancement plantings (1000 stems/acre) Fertilizer application/maintenance Lime and seed application on SSR Surface compost application Noxious weed control
Technical Feasibility	Actions are technically feasible	Actions are technically feasible and typical of forestry and mineland reclamation/products commercially available	Actions are technically feasible and typical of mineland and contaminated site reclamation/ products are commercially available
Coordination with Remedy	No coordination required	Possible to coordinate several functions and reduce project costs	Possible to coordinate several functions and reduce project costs
Anticipated Ecological Response	Functional replication	Functional and partial structural replication.	Functional and partial structural replication
Effectiveness & Risks of Strategy	High risk—resulting restoration may not recover to baseline and further degrade	Moderate risk—mid-successional species will establish, but soil factors may inhibit further succession and extend recovery	Low risk—mid- and late-successional species will establish, full structural restoration may not occur
Potential of Additional Injury	Potential erosion and noxious weed invasion on slopes	Soil disturbance will possibly result in noxious weed establishment	Soil disturbance will possibly result in noxious weed establishment
Potential Effects on Human Health and Safety	Extended exposure to COCs from eroding slopes	Short-term exposure to implementation crews to COCs	Short-term exposure to implementation crews to COCs
Appropriate Application Area	WV adjacent to native stands	Sites with limited species diversity and soils with chemical and physical deficiencies	Sites with limited species diversity and soils with chemical and physical deficiencies as well as requiring minimum time to recovery
Time for Recovery to Baseline	>500 years	<100 years	<50 years
Anticipated Costs	$ 0.00	$27,656,257	$72,357,000

The goal of the *No Action Alternative* is to allow areas to follow a recovery trajectory dictated by site conditions following the remedial actions. This alternative will rely entirely upon natural recovery and would result in an extensive amount of time for recovery of natural resources to baseline conditions, a steady state consisting of only those vegetation species utilized in remedial prescriptions, or a trajectory of site degradation with no or minimal restoration of natural resources. This alternative recognizes that remedy may succeed in partially restoring the potential ability of a site to recover naturally while accepting risks of failure or further degradation. This alternative will not actively pursue restoration and would not result in ecosystem health, richness of plant species, and diversity of structure characteristic of baseline conditions. Under the *No Action Alternative*, recovery to conditions somewhat similar to baseline on the Injured Area will not occur for a time period of about 500 years.

The goal of the *Active Restoration Alternative* is to restore mid-successional plant communities and initiate a trajectory of recovery toward conditions characteristic of baseline. Components of this alternative include enhancement plantings of mid-successional species at 500 stems/acre, application of amendments to plantings, initial organic fertilizer application, aerial lime treatments on steep areas, and maintenance as necessary. Climax species composition and structural diversity are not a primary concern of this alternative which will rely upon natural recovery to some degree. Recovery time to baseline will be significantly reduced compared to the *No Action Alternative* due to the extension of plantings across the entire area of disturbance and to the appropriate distribution of grassland and woody species across the site. Not considered is the development of soils, which may take centuries to accomplish. Anticipated time to recovery to baseline conditions is less than 100 years.

The goal of the *Intensive Restoration Alternative* is to restore mid- to late-successional plant communities and initiate an accelerated trajectory of restoration toward baseline conditions. This alternative recognizes the need to restore wildlife habitat consisting of mid- to late-successional plant

species capable of supporting a variety of native plant, insect, avian, and mammal life. This alternative will rely upon intensive restoration efforts and minimize the time for restoration of wildlife habitat to baseline conditions, which would occur in less than 50 years. Components of this alternative include enhancement plantings of mid- and late-successional species at 1000 stems/acre, surface and sub-surface compost application, lime treatments on steep areas, and maintenance as necessary. This alternative places minor emphasis on natural recovery as a tool and will minimize the time required to create a sustainable plant community with wildlife habitat values similar to baseline.

4.2.1 Technical Feasibility

The treatments slated for both the *Active* and *Intensive Restoration Alternatives* are technically feasible and are typical of forestry and mine land reclamation. BRI developed restoration treatments for the remedial treatment areas proposed under the ROD and Work Plans. These restoration treatments are set forth in Section 6 of **Appendix B**. To maximize coordination with remedial efforts, almost all restoration activities are slated to occur between 2003 and 2014.

4.2.2 Cost-Effectiveness

The restoration benefits to natural resources of the Smelter Hill and Stucky Ridge Injured Areas vary greatly between the three alternatives. To determine cost-effectiveness of the alternatives, the State examined how effectively each alternative will produce site conditions that optimize the recovery of natural resources to baseline conditions.

The *No Action Alternative* produces no restoration benefits in addition to those that may result from implementation of the remedial action. Unlike the Mount Haggin Injured Area, remedial prescriptions will be implemented on a majority of the Smelter Hill and Stucky Ridge Injured Areas.

While the remedial action may produce some restoration benefits, failure to implement additional restoration actions will result in an extensive amount of time for recovery of natural resources to baseline conditions

The *Active Restoration Alternative* proposes restoration actions designed to enhance remedial prescriptions on most of the Smelter Hill and Stucky Ridge Injured Areas. Implementation of this alternative will effectively establish a species composition and diversity from which baseline conditions will eventually be restored. Although this alternative may not result in restoring baseline conditions in the near future, the alternative will create conditions designed to promote recovery to baseline conditions and, compared to the *No Action Alternative*, significantly reduce the time of recovery to baseline conditions for the natural resources of the Smelter Hill and Stucky Ridge Injured Areas.

The *Intensive Restoration Alternative* proposes more intensive restoration activities. Through increased planting densities and soil enhancements, this alternative will effectively create soil conditions, species composition and structural diversity necessary for the restoration of baseline conditions in a significantly shorter period of time than the *Active Restoration Alternative*.

4.2.3 Results of Response Actions

The restoration alternatives may be coordinated with implementation of remedial prescriptions and will complement and enhance remedial actions throughout the Smelter Hill and Stucky Ridge Injured Areas. Measures to insure coordination with remedy include the following:

1) *Tillage Areas:* In the 1,768 acres of Tillage areas the *Active Restoration Alternative* efforts will coordinate remedial tilling, liming, and drill seeding by adding organic fertilizer, compost and 500 plants/acre. In the Work Plans, organic matter placement is slated to occur in only 45 acres of Stucky Ridge at a rate of 20 cubic yards/acre. If indeed this compost is placed in these areas, and if any additional compost is applied in remedial areas, compost addition under the restoration alternative will be reduced accordingly. Under the *Intensive Restoration Alternative* compost incorporation, broadcast seeding, and

plantings of 1000 plants/acre are the additional planned treatments in addition to the remedial actions.

2) *Steep Slope Reclamation Areas:* In the 1,580 acres of remedial Steep Slope Reclamation (SSR), *Active* and *Intensive Restoration Alternative* efforts will coordinate with remedial actions. Remedial prescriptions propose the planting of 500 trees/shrubs per acre, broadcast seeding, and erosion control measures such as dozer basins, slope regarding, and "brush boxes." Additional restoration treatments proposed under the *Active Restoration Alternative* include aerial lime and fertilizer application, planting of an additional 500 trees/shrubs per acre, and biological weed control. Treatments proposed under the *Intensive Restoration Alternative* include aerial liming, fertilizing, and composting, along with planting of an additional 1000 trees/shrubs per acre.

3) *Vegetation Improvement Acres:* In the 246 acres of remedial action VI, *Active* and *Intensive Restoration Alternative* efforts will coordinate with remedial actions. Remedy proposes a minimal level of treatment such as weed spraying and light tilling (4 to 6 inches), with possible lime and/or fertilizer addition and drill seeding. Additional restoration treatments proposed under the *Active Restoration Alternative* include planting of 500 trees/shrubs per acre and biological weed control. The *Intensive Restoration Alternative* includes planting an additional 1000 trees/shrubs per acre and biological weed control.

4) *Well Vegetated Areas:* Because remedy proposes only vegetation monitoring in these 1,106 acres, little coordination of efforts will be needed. Treatments proposed under the *Active* and *Intensive Restoration Alternatives* include plantings of 500 and 1000 trees/shrubs per acre respectively. Biological weed control is also proposed under both restoration treatment alternatives.

4.2.4 Potential for Additional Injury

Environmental impacts from implementation of either restoration alternative will be short-term and insignificant. Such impacts may include dust disturbance during organic matter and fertilizer placement. Measures designed to mitigate any adverse impacts will be taken. Selection of the *No Action Alternative*, however, will result in continued significant adverse impacts to natural resources in the Smelter Hill and Stucky Ridge Injured Areas such as further erosion, noxious weed invasion, an extensive amount of time for recovery of natural resources to baseline conditions.

4.2.5 Natural Recovery and the Ability of the Resource to Recover

Due to the severe injuries in the Smelter Hill and Stucky Ridge Injured Areas, estimating recovery to baseline is a difficult task. Remedial and restoration actions, however, will significantly enhance the ability of the natural resources to recover. As stated in the previous section, a failure to implement restoration actions could result in further erosion, noxious weed invasion, an extensive amount of time for recovery of natural resources to baseline conditions, a steady state consisting of only those vegetation species utilized in remedial prescriptions, or a trajectory of site degradation with no or minimal restoration of natural resources. Without implementation of restoration actions to augment remedial prescriptions, baseline conditions will not return to the Smelter Hill and Stucky Ridge Injured Areas for a time period of about 500 years, and it may be longer than that for soil conditions to return to baseline. The timeline for recovery to baseline conditions should be significantly shortened to between 50 and 100 years under the *Active Restoration Alternative*. Time for recovery to baseline conditions under the *Intensive Restoration Alternative* will be further shortened to less than 50 years.

4.2.6 Human Health and Safety

There are no significant human health and safety issues associated with these alternatives. Alternatives would be designed and implemented to ensure both workplace safety and public health.

4.2.7 Federal, State, and Tribal Laws

The alternatives are consistent with applicable law. Before taking any action, the State would obtain all necessary permits and authorizations.

4.2.8 Cost-Benefit/Decision Making Analysis

The costs of the alternatives, which are displayed on the attached cost sheets (**Table 6**), are $0 for the *No Action Alternative*, $27.7 million for the *Active Restoration Alternative* and $72.3 million for the *Intensive Restoration Alternative*. The State selects the *Active Restoration Alternative* of $27.7 million. The primary elements in this alternative are tree and shrub plantings and aerial application of lime on SSR areas. These two components comprise almost 87% ($24 million) of the $27.7 million.

The selected alternative does not reduce the time for restoration of baseline conditions to the extent achieved under the *Intensive Restoration Alternative*. The *Active Restoration Alternative*, however, proposes reasonable measures which optimize site-specific conditions favorable to, in the long term, restoration of baseline conditions at less than one-half the cost of the *Intensive Restoration Alternative.* The State does not select the *No Action Alternative* because of further erosion, noxious weed invasion, an extensive amount of time for recovery of natural resources to baseline conditions, a steady state consisting of only those vegetation species utilized in remedial prescriptions, or a trajectory of site degradation with no or minimal restoration of natural resources inherent in this course of action.

TABLE 6

SMELTER HILL and STUCKY RIDGE COSTS

Treatment	**Total Acres Per Treatment**	**ARA[1] cost/acre Net Present Value**	**IRA[2] cost/acre Net Present Value**	**Total to Implement ARA - Net Present Value**	**Total to Implement IRA - Net Present Value**
Tillage (T6/T12)	1,768	$5,148[3]	$17,410	$9,102,317	$30,781,177
Vegetation Improvement (VI)	246	$4,500	$8,624	$1,108,294	$2,124,069
Steep Slope Reclamation (SSR)	1,580	$8,572	$20,121	$13,544,265	$31,791,285
Well Vegetated (WV)	1,106	$3,527	$6,926	$3,901,381	$7,660,470
TOTALS	**4,700**			**$27,656,257**	**$72,357,001**

[1] ARA – Active Restoration Alternative
[2] IRA – Intensive Restoration Alternative
[3] All costs listed in the above table are adjusted for Net Present Value